REMARKS

After the foregoing Amendment, claims 1-20 are currently pending in this application. Claim 21 is canceled without prejudice. Claims 1, 3-4, 6-7, 9-11, 15, and 16-20 are amended without prejudice. In the specification, the title is amended. The amendments are supported by the originally filed specification and Applicant submits that no new matter has been introduced into the application by these amendments.

***Claim Rejections - 35 USC* §112, second paragraph**

The Action rejects claims 1-21 as indefinite. Obviating amendments are made. Applicant believes that the rejections are overcome and requests withdrawal of the same.

***Claim Rejections - 35 USC* §103**

The Action rejects claims 1-21 as obvious over U.S. patent No. 3,574,591 (Lyons) or U.S. patent No. 3,856,500 (Cox). Claim 21 is cancelled and its rejection is moot. The Action admits that neither Lyons nor Cox teaches a method including an iron or manganese polyphosphate. However, the Action refers to portions of Lyons or Cox where manganese or iron appear.

Claim 1, as amended, recites:

> A process for the preparation of water insoluble, bio-release iron-manganese polyphosphate fertilizer, which comprises

a) heating phosphoric acid at a temperature above 160°C with a mixture of (i) a source of iron oxide including one or more substance selected from the group consisting of goethite and hematite, (ii) pyrolusite and (iii) one or more basic compound(s) selected from the group consisting of oxide(s), and carbonate(s) of magnesium, calcium, sodium and potassium, for a time period ranging from 20 min to 2 hr, thereby producing a liquid which has an appropriate degree of incomplete polymerization as characterized by solubility in 0.33M citric acid and 0.005M DTPA of the neutralized product in stage (b), followed by

b) neutralization of the liquid polyphosphate then

c) drying the neutralized material to obtain a solid and

d) pulverization.

Applicant submits that Lyons is directed to a process that provides fertilizer containing plant nutrients of nitrogen, phosphorous, iron, manganese and/or zinc, which are slowly soluble and have the same or controlled solubility rate for plant nutrients. Lyons specifically relates to providing a composition which contains mixed cation polyphosphate having solubility characteristics and other physical characteristics desirable in slow release fertilizer. See Lyons, column 1, lines 55-63. The process disclosed in Lyons is described in column 2, lines 7 to 20, which teaches that the compounds are prepared by thermal condensation of i) an ammoniating condensing agent, ii) a nitrogen containing material such as ammonium phosphate, potassium containing material selected from mono-potassium ortho phosphate etc. and iii) a source of plant nutrient selected from the group consisting of iron,

manganese, copper, and zinc. The essential steps of the process of Lyons includes thermal condensation of an ammoniating condensing agent, nitrogen containing material and a source of plant nutrient material. In column 3, second paragraph, Lyons teaches the source of the phosphate, which includes ortho phosphoric acid. In column 3, last paragraph, Lyons teaches that the ammoniating and the condensing are urea, bi-urea etc.

The Action refers to Lyons, column 4 to column 6 where the ortho phosphoric acid and the plant nutrient are mentioned. The essential element in Lyons, namely the ammoniating and the condensing agent are absent in the present invention. Since Lyons teaches a process requiring these elements, Lyons teaches away from the claimed invention. Indeed, one of ordinary skill in the art would not learn from Lyons that these ingredients could be omitted.

Lyons achieves a slow release fertilizer containing nutrients like magnesium, manganese, iron etc. by a composition which is formed by thermal condensation of ammoniating, condensing agent, nitrogen containing material and plant nutrients. In contrast, the claimed invention recites a single stage reaction of heating phosphoric acid at temperature above 160°C with source of iron oxide, manganese, magnesium, neutralizing the same, drying the neutralizing material and pulverizing the same. Accordingly, claimed invention is substantially different than

the method taught in Lyons. Applicant believes that Lyons does not render the claimed invention obvious.

Applicant submits that Cox relates to finely divided heavy metal potassium polyphosphate and liquid fertilizer containing such finely divided solids. At column 1, Cox clearly differentiates liquid fertilizers and solid fertilizer providing advantages of the former over the latter. Cox teaches providing a substantial amount of heavy metal micro nutrient in liquid fertilizer where the heavy metal components may or may not be in the finely divided phase. The preferred feature of Cox is providing finely divided heavy metal potassium polyphosphate solid, which are dispersed or suspended in the liquid phase. At column 2, Cox teaches special dimensions required for formation of the dispersed. At column 3, the process of obtaining the formulation is described, which involves reaction of ingredients in several ways. The micronutrients are maintained in solution as much as possible. The temperature of the neutralizing reaction is 30-90^{0}C. Unlike the claimed invention, Cox does not teach heating the components to above 160^{0}C. In contrast, the temperature range of 30-90^{0}C teaches away from the claimed invention.

In Cox, the preferred starting material is super phosphoric acid. Thus a pre-polymerized phosphoric acid is used and other compounds are added to it and dissolved in it. In the claimed invention, the starting material is ortho phosphoric acid. Polymerization of the phosphoric acid is a crucial step, which is required to

dissolve the iron and manganese oxides and integrate these cations into the polyphosphate chain. Applicant submits, that the unlike Cox, the claimed invention does not form specific suspensions of components. Moreover the ratio in Cox is different for iron oxide and pyrolusite.

Further distinguishing features:

A. Lyons

(1) In the process described by Lyons, an inorganic phosphate is condensed with a "condensing and ammoniating agent" containing an amide group (such as urea). Presence of a condensing agent is an integral and essential part of their invention, which is repeatedly emphasized (*e.g.*, Abstract, column 1, line 19; claim 1, line 61-62; claim 2, column 2, line 9; column 3, last paragraph; column 4, line 25; column 5, line 6; column 5, line 59; Example 1, line 33).

In claimed process, no such condensing agent is required for the polymerization of ortho phosphoric acid and reaction with the metal oxides occurs without any such condensing agent. It is only after the polymerization is complete that ammonia or other bases are added to neutralize the liquid (see claim 1; page 6, paragraph 2-3; Examples 1 to 10).

(2) In Lyons, a potassium containing material is another integral component of the reaction mixture; the reaction is never carried out in the absence of a potassium salt (abstract, line 17; claim 1, line 62; claim 4; claim 7, Example 1 line 32; column

2, line 10; column 2, line 62; column 4, line 38; column 4, line 9; column 5, line 9; column 5, line 67; column 6, paragraph 2).

In the claimed process, potassium base is an optional component and is used as an alternative to magnesium, calcium or sodium (claim 1; Examples 1-4, 6-10; page 7, last paragraph).

(3) In the process described by Lyons, a solid product, *i.e.* water insoluble product, is obtained after heating phosphoric acid <u>with condensing agents</u>, potassium salts and metal salts (column 5, paragraph 2).

In the claimed process, the first stage of reaction produces a liquid polyphosphate. This is a fundamental and major difference between the two processes. The liquid polyphosphate is then neutralized with a base and subsequently dried to obtain a solid (page 8, last paragraph to page 9; first paragraph; page 10, first paragraph; Examples 1,2 *etc.*; claim 1, as amended). To clarify further, a polymerized product, which is liquid, is chemically different from a product which solid. A liquid product implies that the degree of polymerization is low. A solid product implies that polymerization is very high and polycondensation has occurred to the extent that almost all structural water is lost. Consequently, reaction periods are much higher for the product of the Lyons.

The time periods of the polymerization stage are significantly different in the two processes. Lyons refers to a time period of 20 to 26 hours at 170 to 260^{0}C

(column 5, line 45) and 22 hours at 275^{0}C (Example 1). In the claimed process, time periods are very much less and range from 1 to 2 hours (See also Examples 1 to 10).

(4) The polyphosphates described in Lyons are long chain polymeric materials (column 2, line 16-17) with number average chain lengths from 20-400. In other words, the reaction has been carried out to complete the polymerization and obtain long chain compounds which are solids.

In the claimed process, polymerization is not allowed to complete so that the polyphosphate remains in a liquid state. Polymerization is only done up to a particular level as defined by chemical tests (page 9, lines 7-15; Examples 1, 2).

Not only is the process described in Lyons patent significantly different from the claimed process; the chemical nature of the product itself is substantially different.

B. Cox

(1) Cox teaches a liquid form. In fact it teaches that the liquid form is better than the solid form, including powders. The claimed process can produce powdered forms and yet provides a desired effect and hence the prior art teaches away from the claimed process.

(2) The liquid end product produced by Cox "contains at least one chelating agent" (claim 4) such as gluconic acid, citric acid, tartaric acid, etc. (claim5). The claimed process uses no such chelating agent.

(3) In the process as described in Cox, the acid used is superphosphoric acid (Examples I-XXVIII). In all examples, only superphosphoric acid has been used. However, in column 3, second paragraph, it is mentioned that orthophosphoric acid may also be used by partially neutralizing and then condensing but no further process details are provided anywhere in the description of how this is to be done. Wherever process details and examples are available, the reaction is with superphosphoric acid, rather than orthophosphoric acid. If orthophosphoric acid is used instead, under the same conditions, no polymerization will occur at temperatures as low as 30-90^{0}C. The boiling point of orthophosphoric acid is around 150^{0}C and this continues to increase with polymerization. Therefore, under the mild vacuum and low temperature conditions described, a mixture of manganese dioxide or ferric oxide and potassium hydroxide and superphosphoric acid will not yield an iron or manganese polyphosphate.

(4) In the claimed process, metal oxides are converted to dihydrogen phosphates by reaction with phosphoric acid. Subsequently, the dihydrogen phosphates are polymerized by heating. In the process described in Cox, metal compounds such as ferric oxide and manganese dioxide are added to aqueous potassium hydroxide which is then mixed with superphosphoric acid. Cox did not, however, describe the reaction chemistry of its process; it is not clear how manganese dioxide or ferric oxide will react when mixed with potassium hydroxide solution without strong

heating. Generally, fusion temperatures above the melting point of KOH will be needed to dissolve the manganese or iron oxide. Therefore, the two processes are chemically different.

(5) Reaction temperatures in Cox are only due to internal heat generated by the neutralization of superphosphoric acid by KOH which is maintained at low levels (30-90^{0}C) to avoid hydrolysis of polyphosphate (column 4, last paragraph; column 6, second paragraph). As such, no external heating has been applied to polymerize the phosphates.

Based on the foregoing, neither Lyons nor Cox, alone or in combination, teach or suggest every element of any one of claims 1 – 20. Applicant believes that the rejection of claims 1-20 as obvious over Lyons or Cox is overcome and requests withdrawal of the same.

Conclusion

If the Examiner believes that any additional matters need to be addressed in order to place this application in condition for allowance, or that a telephone interview will help to advance the prosecution of this application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

In view of the foregoing amendment and remarks, Applicant respectfully submits that the present application, including claims 1-20, is in condition for allowance and a notice to that effect is respectfully requested.

Respectfully submitted,

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